CALRECYCLE
SCOPE OF WORK

"TDA Seismic Retaining Wall Shake-Table Test and
Analysis using Tire Derived Aggregates (TDA) as Backfill"

I. INTRODUCTION/OBJECTIVES:

To promote a larger use of waste tires, a recent application for scrap tires has been investigated as an alternative backfill material for retaining structures to replace the conventional granular backfill. Hundreds of miles of retaining wall systems exist in the western United States. TDA used for backfill in this type of application will significantly reduce the number of waste tires disposed of in landfills and can result in a considerable cost savings in the construction of retaining walls. The objective of this study is to perform a full-scale shake-table test of a standard Type 1 retaining wall backfilled with TDA instead of the conventional soil as used in the previous two tests. Caltrans technical committee and the consulting personnel will be engaged during the entire progression of this research phase. Interim and final reports are required as the deliverables of this phase of the research.

II. WORK TO BE PERFORMED

The initial activities for the project will involve a literature review of all previous seismic testing involving TDA backfill and TDA material characterization. This information will be used to accurately develop the full-scale shake-test model. The Contractor will then perform a full-scale shake-table test of a standard Type 1 retaining wall backfilled with TDA, analyze performance data, and report the test results.

III. TASKS IDENTIFIED

- **Task 1:** Literature review and planning

  A thorough literature review examining the previous and ongoing state-of-the-art work related to the use of TDA as retaining wall backfill will be conducted during this task of the scope of work. The University of California, Davis (UCD) will work closely with Caltrans and CalRecycle to acquire further relevant publications and reports in order to complete this task of work.

  Results will be summarized and documented as part of the quarterly progress report to Caltrans. This task also includes the planning effort on the material characterization tests and the full-scale shake-table test.

Deliverables – A progress report summarizing the literature review.

- **Task 2:** Material characterization tests

UCD will work with Caltrans and CalRecycle to select the desired type of TDA backfill material for the retaining wall shake-table test. The following experimental tests will be performed in order to determine the essential engineering properties related to the use of TDA as backfill material for retaining walls: 1) sieve analysis to determine the gradation per ASTM D422 (ASTM 1994); 2) compaction test using the Modified Proctor method to determine the maximum unit weight; 3) constant head permeability test to determine hydraulic conductivity; 4) direct shear test to determine the shear strength parameters and deformation behavior of the TDA; and 5) triaxial shear test on selected samples to determine the dynamic shear modulus values and damping values at three different confining stresses. ASTM Standards will be carefully followed for these tests. The geotechnical material testing laboratory at UCD and the testing laboratory at the partner consulting company (GeoCON) will be utilized to conduct this task.

Deliverables – A set of performance data and a report documenting the material test results.

- **Task 3:** Full-scale shake-table test

A similar Semi-Gravity Reinforced Concrete Cantilever walls (Type 1) as used in the previous project tests will be constructed for this work. Even though the retaining wall in the previous test was not damaged during the shake-table test, the strain gages on the rebar inside the wall and the concrete material might experience deterioration over time due to the outdoor storage condition at the site. Therefore, a new wall specimen will be constructed during this phase of work. The type of TDA materials to be used, after careful discussions with Caltrans and CalRecycle, will be selected from the available vendors. To allow for direct comparison, the test setup configuration (as shown in Fig. 1 below), instrumentation plan and loading protocols will be kept the same as with the previous wall tests (see Task 4 attachment 2). The wall will be supported by a flexible shallow soil foundation (3.5-ft thick Caltrans specified soil). The compaction of the TDA backfill materials will be subcontracted to a local certified company (to be determined). Only one single shake-table test will be performed during this phase.

Deliverables – A set of performance data and a report documenting the test results.

- **Task 4:** Evaluation of design using existing Caltrans guidelines

  During this task, the design of retaining walls backfilled with TDA materials using the existing Caltrans Design Guidelines will be evaluated. The applicability and limitations will be closely examined.

Deliverables – A report evaluating the design of Type 1 retaining walls backfilled with TDA materials using the existing Caltrans Design Guidelines.

- **Task 5:** Preparation of final report

  A complete and detailed final report will be prepared in this task and submitted at the end of the project.

Deliverables – A final report documenting all the research findings in the proposed scope of work.

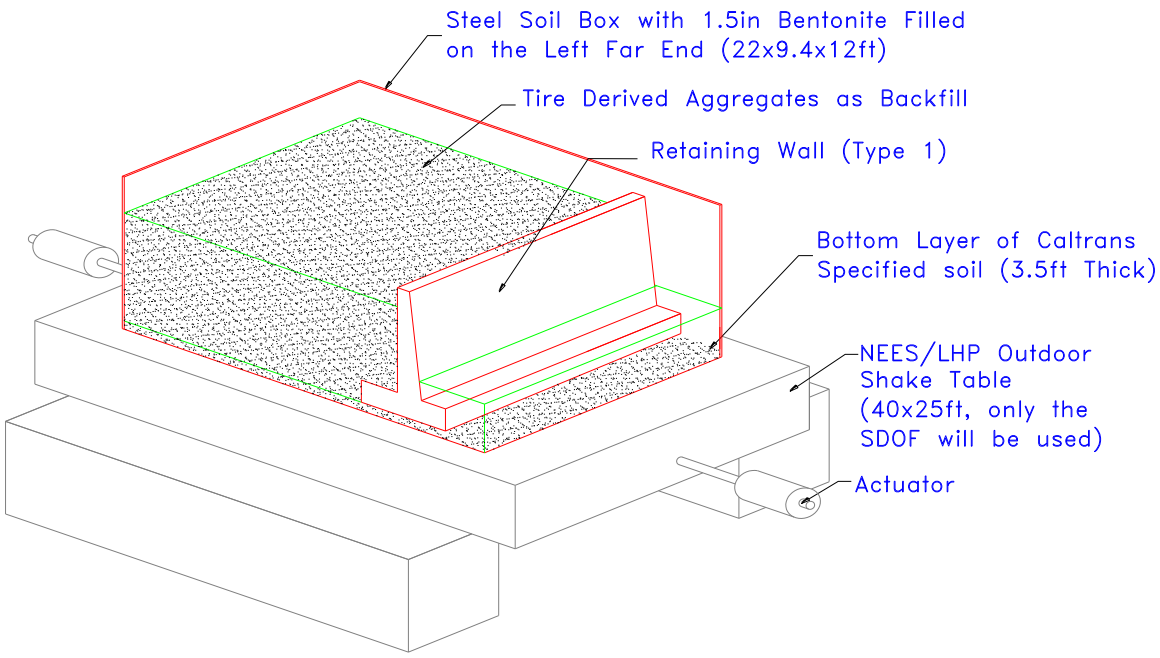

Fig. 1. Test setup configuration using NEES-UCSD shake-table

IV. CONTRACT/TASK TIME FRAME :

Task Description		Months								
		3	6	9	12	15	18	21	24	27
Task 1: Literature review and planning										
Task 2: Material characterization tests										
Task 3: Full-scale shake-table test	Planning, preparation and construction									
	Setup and testing									
Task 4: Evaluation of design using existing Caltrans guidelines										
Task 5: Preparation of final report										
Project Meeting with Caltrans		●		●		●	●		●	●
Deliverables*		(1)		(2)			(3)			(4,5)

Contract is scheduled to begin July 1, 2010 with completion by December 30, 2012.

The following provisions will be included in the Terms and Conditions or Special Terms and Conditions of the Contract:

V. COPYRIGHT PROVISION

The Contractor shall assign to the Department of Resources Recycling and Recovery (CalRecycle) any and all rights, title and interests to any copyrightable material or trademarkable material created or developed in whole or in any part as a result of this Agreement, including the right to register for copyright or trademark of such materials. The Contractor shall require that its subcontractors agree that all such materials shall be the property of the CalRecycle. Such title will include exclusive copyrights and trademarks in the name of the CalRecycle.

VI. CALIFORNIA WASTE TIRES

Unless otherwise provided for in this Scope of Work, in the event the Contractor and/or subcontractor(s) purchases waste tires or waste-tire derived products for the performance of this Scope of Work, only California waste tires and California waste tire-derived products shall be used. As a condition of payment under the agreement, the Contractor shall be required to provide documentation substantiating the source of the tire materials used during the performance of this Scope of Work to the CalRecycle Contract Manager.

VII. WASTE REDUCTION AND RECYCLED-CONTENT PRODUCT PROCUREMENT

In the performance of this Agreement, Contractor shall use recycled content, used or reusable products, and practice other waste reduction measures where feasible and appropriate.

Recycled Content Products: All products purchased and charged/billed to CalRecycle to fulfill the requirements of this contract shall be Recycled Content Products (RCPs), or used (reused, remanufactured, refurbished) products. All RCPs purchased or charged/billed to CalRecycle to fulfill the requirements of the contract shall have both the total recycled-content (TRC) and the postconsumer content (PC) clearly identified on the products. Specific requirements for the aforementioned purchases and identification are discussed in the Terms and Conditions of the Contractual Agreement under Recycled-Content Product Purchasing and Certification.

The Contractor should, at a minimum, ensure that the following issues are addressed, as applicable to the services provided:

A. WRITTEN DOCUMENT PROVISION

All documents and/or reports drafted for publication by or for CalRecycle in accordance with this contract shall adhere to CalRecycle's *Guidelines For Preparing CalRecycle Reports (available upon request)* and shall be reviewed by CalRecycle's Contract Manager in consultation with one of CalRecycle's editors.

In addition, these documents and/or reports shall be printed double-sided on one hundred percent (100%) recycled-content paper. Specific pages containing full-color photographs or other ink-intensive graphics may be printed on photographic paper. The paper should identify the postconsumer recycled content of the paper (i.e., "printed on 100% postconsumer paper"). When applicable, the Contractor shall provide the Contract Manager with an electronic copy of the document and/or report for CalRecycle's uses.

To the greatest extent possible, soy ink instead of petroleum-based inks should be used to print all documents.